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14. ABSTRACT
The Sisseton Wahpeton College (SWC), as stated in the proposal, focused its efforts on upgrading the instructional technology and network infrastructure at the college to support STEM education and research. One of the key elements was increasing our network backbone from 1Gbs to 10Gbs. This was accomplished by acquiring Cisco Core Switches, which is also allowing for the consolidation of wiring closets and increasing reliability. By connecting the individual buildings on campus on 10Gbs fiber optic lines, SWC was able to effectively migrate to a virtual server environment. While the college's two Cisco blade servers are located in separate buildings, these

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Report Title

Final Report: Improving STEM Education and Workforce Development by the Inclusion of Research Experiences in the Curriculum at SWC

ABSTRACT

The Sisseton Wahpeton College (SWC), as stated in the proposal, focused its efforts on upgrading the instructional technology and network infrastructure at the college to support STEM education and research. One of the key elements was increasing our network backbone from 1Gbs to 10Gbs. This was accomplished by acquiring Cisco Core Switches, which is also allowing for the consolidation of wiring closets and increasing reliability. By connecting the individual buildings on campus on 10Gbs fiber optic lines, SWC was able to effectively migrate to a virtual server environment. While the college's two Cisco blade-servers are located in separate buildings, these units now work as one unit. Critical databases and software packages are mirrored on each of the systems, which allow a near seamless transition during a hardware failure and eliminates downtime for most maintenance.

The support of the Department of Defense in this project has also allowed us to leverage funds from other sources, including the Department of Education (in excess of $189,000), USDA Rural Development (approximately $34,000), and National Science Foundation (est. $50,000)

Enter List of papers submitted or published that acknowledge ARO support from the start of the project to the date of this printing. List the papers, including journal references, in the following categories:

(a) Papers published in peer-reviewed journals (N/A for none)

Received Paper

TOTAL:

Number of Papers published in peer-reviewed journals:

(b) Papers published in non-peer-reviewed journals (N/A for none)

Received Paper

TOTAL:

Number of Papers published in non peer-reviewed journals:

(c) Presentations

Number of Presentations: 0.00

Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

Received Paper

TOTAL:

Number of Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

Peer-Reviewed Conference Proceeding publications (other than abstracts):

Received Paper

TOTAL:

Number of Peer-Reviewed Conference Proceeding publications (other than abstracts):

(d) Manuscripts

Received Paper

TOTAL:

Number of Manuscripts:

Books

Received Book

TOTAL:

Received	Book Chapter

TOTAL:

Patents Submitted

Patents Awarded

Awards

Graduate Students

NAME	PERCENT_SUPPORTED

FTE Equivalent:
Total Number:

Names of Post Doctorates

NAME	PERCENT_SUPPORTED

FTE Equivalent:
Total Number:

Names of Faculty Supported

NAME	PERCENT_SUPPORTED

FTE Equivalent:
Total Number:

Names of Under Graduate students supported

NAME	PERCENT_SUPPORTED

FTE Equivalent:
Total Number:

Student Metrics

This section only applies to graduating undergraduates supported by this agreement in this reporting period

The number of undergraduates funded by this agreement who graduated during this period: 0.00

The number of undergraduates funded by this agreement who graduated during this period with a degree in science, mathematics, engineering, or technology fields:..... 0.00

The number of undergraduates funded by your agreement who graduated during this period and will continue to pursue a graduate or Ph.D. degree in science, mathematics, engineering, or technology fields:..... 0.00

Number of graduating undergraduates who achieved a 3.5 GPA to 4.0 (4.0 max scale):..... 0.00

Number of graduating undergraduates funded by a DoD funded Center of Excellence grant for Education, Research and Engineering:..... 0.00

The number of undergraduates funded by your agreement who graduated during this period and intend to work for the Department of Defense 0.00

The number of undergraduates funded by your agreement who graduated during this period and will receive scholarships or fellowships for further studies in science, mathematics, engineering or technology fields:..... 0.00

Names of Personnel receiving masters degrees

NAME

Total Number:

Names of personnel receiving PHDs

NAME

Total Number:

Names of other research staff

NAME PERCENT_SUPPORTED

FTE Equivalent:
Total Number:

Sub Contractors (DD882)

Inventions (DD882)

Scientific Progress

The Sisseton Wahpeton College (SWC), as stated in the proposal, focused its efforts on upgrading the instructional technology and network infrastructure at the college to support STEM education and research. One of the key elements was increasing our network backbone from 1Gbs to 10Gbs. This was accomplished by acquiring Cisco Core Switches, which is also allowing for the consolidation of wiring closets and increasing reliability. By connecting the individual buildings on campus on 10Gbs fiber optic lines, SWC was able to effectively migrate to a virtual server environment.

While the college's two Cisco blade-servers are located in separate buildings, these units now work as one unit. Critical databases and software packages are mirrored on each of the systems, which allow a near seamless transition during a hardware failure and eliminates downtime for most maintenance. As a not only is the issue of database backups been addressed, but even in the case of a fire or other major disaster the critical operations of the college can be maintained.

SWC is leading an effort on the Lake Traverse Reservation in Northeastern South Dakota to improve STEM education by incorporating research experiences in classroom curriculum. As mentioned in the proposal several collaborative projects are in place where SWC works with other universities. Beyond the work of the Computer Science and Technology (CST) Department with the South Dakota EPSCoR program, the National Science Foundation (NSF) funded a project to develop a behavioral science degree program. Over the last year a strong partnership has been forged with North Dakota State University (NDSU) and South Dakota State University (SDSU). Through this partnership we are developing course modules to integrate 'research' experiences into the curriculum. This will require a fairly significant database at SWC, in addition to ongoing access to the census data-center at SDSU. Our three institutions are also preparing to submit a research project to NSF this summer.

The support of the Department of Defense in this project has also allowed us to leverage funds from other sources, including the Department of Education (in excess of $189,000) towards upgrading the server-rooms, switches, and other network infrastructure. Although a far lesser amounts were leveraged from the USDA Rural Development (approximately $34,000) for electrical, generator, and cooling systems, the impact of both projects were significantly increased. NSF-TCUP and EPSCoR funds leveraged are more difficult to estimate, as they provided personnel and student helpdesk time, it is likely to around the $50,000 mark.

Additional Information is uploaded as an attachment.

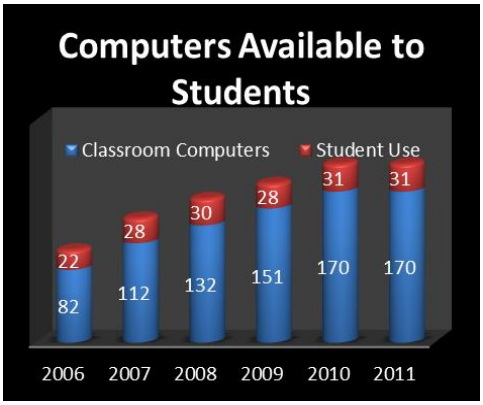
Technology Transfer

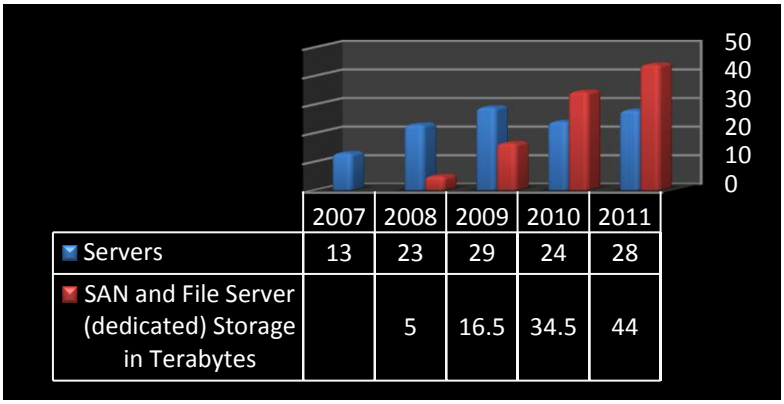
Sisseton Wahpeton College
Final Narrative Report to the
Department of Defense
W911NF-15-1-0052

Improving STEM Education and Workforce Development by the Inclusion of Research Experiences in the Curriculum at SWC

The Department of Defense has played a crucial role in developing the instructional and technological infrastructure at the Sisseton Wahpeton College (SWC). Since 2003 our college received six awards from either the TCU or HBCU/MI programs. When one takes a moment to consider the impact of these grants at SWC, it is a bit overwhelming.

Being a small tribal college that receives no support from the state or the tribal governments our budgets are exceptionally limited. Prior to 2002 all of our faculty shared three computers and there was only one small classroom with about a dozen outdated computers. The funding from the first three awards from the Department of Defense focused on expanding the number of computers available to students and developing our nearly non-existent network. Those efforts were very successful as we have previously reported, improving the ratio of computer to students from about 1:10 to nearly 1:1. In 2000 only a small portion of the campus was networked, while now even with nearly a four-fold increase in square footage the entire campus is connected.





	2007	2008	2009	2010	2011
Servers	13	23	29	24	28
SAN and File Server (dedicated) Storage in Terabytes		5	16.5	34.5	44

The last three awards focused more on the quality, utilization, and security of the college's technology infrastructure. Greater attention was given to instructional technologies that enhanced instruction and student learning in the STEM fields. This also included more instrumentation for the science and computer laboratories. Classrooms were provided with up-to-date instructional technology, such as SmartBoards, Elmo Cameras, and current software.

This grant from the Department of Defense focused on the network infrastructure; helping SWC to migrate from a collection of nearly 30 separate servers to virtual environment hosted on two blade servers. This allows for greater reliability and redundancy as if a single blade becomes inoperative another can seamlessly pick up its

functions, and we are also able to transition from one blade server to the other in a more catastrophic event or even for simple maintenance. This transition also required major upgrades to the physical network media, primarily the adoption of a 10Gb backbone between the buildings, core switches, and the blade servers.

With this funding from the Department of Defense grant SWC purchased two Cisco Catalyst 4507R7 Core Switches, with appropriate modules, and the smaller Cisco 3750X switches for secondary wiring closets. Two large power arrays were also purchased to provide backup power for the two IT rooms housing the blade servers. To ensure the functionality of this equipment the college acquired a new rack with cooling unit. SWC was able to secure better prices for the individual items due to educational discounts and a manufacturer's promotional program. SWC was also able to leverage significant amount of funds from other sources that extended the impact of this award.

As in the past, SWC utilized your support to leverage additional funds from other sources to increase the overall impact of the project. In this case we worked with the USDA Rural Development program to remodel a former storage area into a dedicated and climate controlled server room. This involved new electrical work and HVAC systems being installed, along with other renovations totaling approximately $34,000. Additional funds were leveraged from the Department of Education's Title III program to support upgrades to the classroom and other remodeling work, along with additional networking devices and software (this amounted to over $189,000). Two National Science Foundation grants provided support through IT salaries and funding our Student Helpdesk, which accomplished a significant amount of the labor for installation and is still working on the massive rewiring of the network. Our Helpdesk students, often in computer/network technician program, gain valuable practical experience and save the college – or this project – thousands of dollars by running and terminating CAT5 cables and fiber optic lines. This form of cooperative interaction doubled the impact of this grant, and provided significant advantages to the other project named.

This convergence has greatly expanded the impact of our efforts beyond that of a single award. Many of the objectives listed in the NSF proposals would not have been feasible without the resources acquired through this grant fund by Department of Defense. Additionally, the increase in our network capacity has impacted several projects on campus.

While the bulk of the network cabling will be redone this summer, the switches and most other items are in place. The server migration is approximately 80% complete, while the new Computer Science Classroom will be fully operational by the fall semester.

Project Implementation:

Objectives

1. Provided support for the development of the new CST and the behavior science programs
    a. Purchased computer workstations for a new CST classroom

        - ***Completed – classroom will be utilized fall semester***
    b. Purchased server operating systems and other software for student labs
        - ***Completed – use in labs is already occurring***
    c. Virtualized servers to run databases for classroom use and collaborative teaching
        - ***Virtualization is completed, in process of migrating servers and databases***
    d. Increase dthe college backbone to 10Gb to access data storage centers on campus
        - ***Instrumentation Needs Met – 10Gb link between the two server rooms (across campus) is completed – Running new cable to upgrade all the campus backbone is scheduled for summer to limit disruptions to students***
2. Increased the use of instructional technologies, hands-on labs or on-the-job experiences, and integrate research experience into the core STEM curriculum to improve student learning
    a. Improve network infrastructure at the college to support the development and delivery of multimedia presentations and virtual labs
        - ***Completed on a network design level – implementation will be completed by fall semester***
    b. Increased the reliability of the network to ensure on-demand access
        - ***Completed***
        - ***Even in the event of a fire or other major event in one of the buildings housing a blade-server, we would still remain operational as the other blade-server would go online.***
3. Develop the capacity to use video conferencing and other distance education strategies to support STEM courses and research by connecting SWC with partner universities
    a. Increased the college backbone to 10Gb
        - ***Instrumentation Needs Met – 10Gb link between the two server rooms (across campus) is completed – Running new cable to upgrade all the campus backbone is scheduled for summer to limit disruptions to students***
4. Increase the capacity to conduct the Environmental Study
    a. Purchase computer workstations and an instructional presentation setup for the Science classroom
        - ***Completed – classroom is currently operational***
    b. Virtualize servers for database
        - ***Virtualization is completed, in process of migrating servers and databases***
    c. Increase the college backbone to 10Gb to access data storage centers on campus
        - ***Completed on a network design level – cabling will be completed by fall semester***

The primary activity to supporting the successful implementation of the project was to acquire and install the resources listed in the budget. This was accomplished in all cases. Due to the time between the submission of the proposal, funding, and our ability to house certain acquisitions there were certain changes in brands and/or models. In a few cases better prices were available due to the quantity purchased or as a result of the price decreases normal with computers and related items. This allowed SWC to purchase higher end models, or where appropriate additional units.

While the full impact and success of this project will not be completely understood for several years, it has already made significant improvements in STEM education at SWC and across the Lake Traverse Reservation. College faculty now have the resources to empower them to develop and implement curricula that expose students to research. These research experiences are increasing student interest in STEM fields and are showing promise in improving success rates in courses. Finally, the network and instructional technology infrastructure put in place as a result of this grant will allow SWC to support STEM instruction and future academic/research projects into the next decade.